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RECENT DEVELOPMENT IN THE VICINITY OF JACKSONVILLE

By Alfred H. Bell

Introduction

Gas was discovered about 6 miles east of Jacksonville as early as 1890, and oil in 1910. Since that time numerous attempts have been made to develop a commercial oil field, but until this year the oil production has been of little importance except for local use. During the fall of 1926 the attention of oil operators was attracted to the Jacksonville area by the completion of a well estimated at 10 barrels by P. C. Irwin and others on the Conklin farm in sec. 18, T. 15 N., R. 9 W. Attempts to extend this production have so far not been successful although a little oil has been found in some of the adjacent wells. In the meantime Timberlake and Higgins of Centralia, and Benoist Brothers and others of Mt. Vernon obtained leases and began operations in the vicinity. As a result of the efforts of Timberlake and Higgins, commercial quantities of oil, as well as gas, have been found. The new drilling has added to previous knowledge of geological conditions in the area, and a brief presentation of the newly acquired data will undoubtedly be of assistance both in the development of the production already discovered and in the search for new oil production in the surrounding territory. The area to which this paper refers is part of that described in a former Survey publication[1].

Field Work

Because of the close spacing of some of the wells, a new plane table survey of the area was made on a scale of 1,000 feet to one inch which is a larger scale than that formerly used. Levels to the oil and gas wells and to as many of the dry holes and abandoned wells as could be located were run from Strawn's Crossing on the Chicago and Alton Railroad. The instrument work was done by Leslie A. Holmes.

[1] Collingwood, D. M., Oil and gas development in the vicinity of Jacksonville: Illinois State Geol. Survey Bull. 44B, 1923.

The surface material of the area is glacial drift and stream deposits, and the topography gives no indication of the subsurface structure. Accordingly the physiographic features are not described in this paper.

Stratigraphy

Beneath the Pleistocene deposits of unconsolidated materials, which vary in thickness from 30 to 100 feet, lie rocks of Pennsylvanian age, largely shale with some interbedded limestone, sandstone, and coal. As the Pennsylvanian strata are bounded both above and below by irregular erosional surfaces, their thickness is variable; it is roughly 200 feet. In the area mapped only two of the wells of which records are available were deep enough to pass through Mississippian strata, and consequently data concerning the older rocks are very limited. One of the wells, Rhodes and Moorehead's Cleary No. 2, went 140 feet into the Kimmswick-Plattin or "Trenton" limestone. A study of cuttings from this well and correlation with the logs of other deep wells in the general region indicate the following probable thicknesses for the formations drilled:

Thickness of Formations Penetrated in Rhodes and Moorehead's Cleary No. 2.

	Thickness *Feet*	Kind of rock
Mississippian	640	Chiefly limestone and shale
Devonian	150	Chiefly limestone
Ordovician		
Maquoketa	200	Shale
Kimmswick-Plattin	140	Limestone

Structure

The stratified rocks of the area are essentially flat-lying and have a gentle regional dip to the east. Owing to the inadequate character of the majority of the well logs available, it was not found practicable to use a Pennsylvanian stratum as the key horizon for a structure contour map. However, the majority of the older logs give the depth to the top of "rock" which presumably represents the top of the Mississippian limestone in most places, and accordingly this was chosen as the key horizon in figure 1. It has the disadvantage of being a surface of unconformity, and therefore the map cannot be considered a structure map in the ordinary sense. The contours represent the topography of the pre-Pennsylvanian erosional surface, modified perhaps by later deformational movements. It is possible, as has

been pointed out[2], that the form of this erosional surface may to some extent have been controlled by the folding of the Mississippian rock strata beneath. Insofar as the upper surface of the porous oil- and gas-bearing zone in the Mississippian conforms with the pre-Pennsylvanian erosional surface, the oil and gas pools in this horizon should have a definite relation to the features shown by the contours. Collingwood's conclusion[3] that the oil and gas of this area "have been found mostly in certain lenses or horizons in the Salem, and are associated with the highest parts of its old eroded surface" must be somewhat modified in the light of the new data here presented.

The more obvious features of the contoured pre-Pennsylvanian surface in T. 15 N., R. 9 W. as shown in figure 1 are enumerated below: Mississippian "highs" occur (1) along the S. line of the SE. ¼ sec. 8, extending eastward into secs. 9 and 16 and S. into sec. 17, (2) in the E. ½ of sec. 5 and adjacent part of sec. 4, (3) NW. ¼ sec. 18, and (4) E. part of sec. 4 and the whole of sec. 3. A synclinal belt trending east-west lies about in the center of secs. 8, 9, and 10. The oil production in both secs. 8 and 18 is situated not on the highest parts of the erosional surfaces, but on the saddles between the highs. The Harris-Conklin gas field in secs. 3 and 2 is associated with a Mississipian high. As would be expected, gas occurs higher on the slopes than oil, but there are exceptions, and the probable explanation is that the upper surface of the porous reservoir rock does not entirely conform with the erosional surface mapped. Some of the gas also comes from producing horizons other than the Salem limestone and would not be expected to be related as is this formation to the features of the pre-Pennsylvanian erosional surface.

Table 1 contains in outline form the material treated in the pages following and when used with the map (fig. 1), gives a summary of the information gained from the wells drilled in the last eight months.

Producing Horizons

Pennsylvanian: Gas from sandstone beds in the Pennsylvanian has been reported in a number of the wells, but at present the only commercial well producing from the Pennsylvanian seems to be Timberlake and Higgins' Cleary No. 2 (map No. 16). This well was drilled into the Salem limestone, but gas having a pressure of 45 pounds was found in a sand from 239 to 247 feet, or about 60 feet above the top of the Salem, which was found at 299 feet.

Salem: Most of the gas and all of the oil so far produced in the area occurs in a Mississippian limestone which has been correlated as the Salem

[2] Collingwood, D. M., Oil and gas development in the vicinity of Jacksonville: Illinois State Geol. Survey Bull. 44B, p. 13, 1923.

[3] Idem., p. 14.

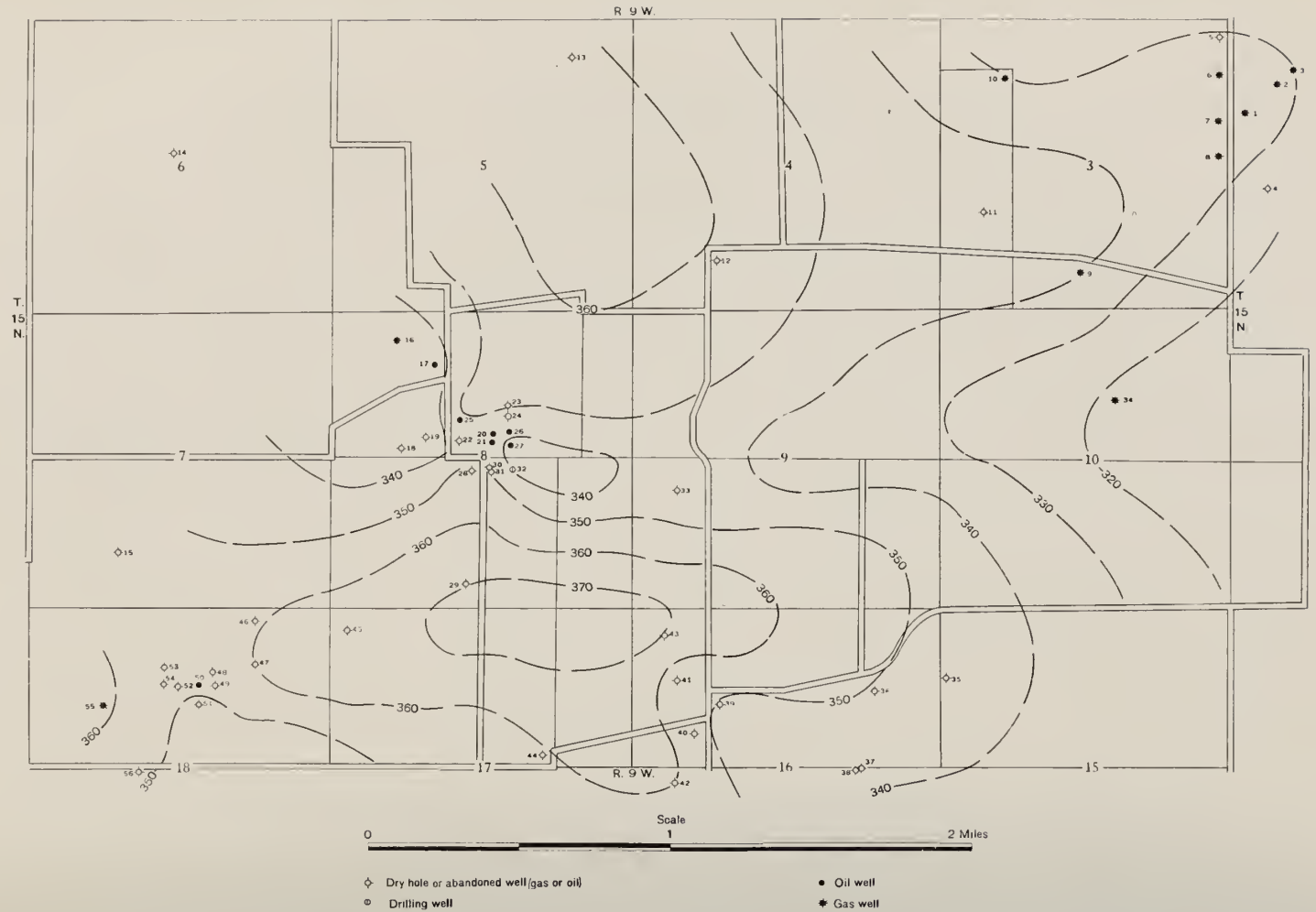

FIG. 1. Structure map of Jacksonville area. Contours represent elevation above sea level of the pre-Pennsylvanian erosional surface. See Table 1, pp. 4 and 5 for well data. (By A. H. Bell, Illinois State Geological Survey.)

TABLE 1.—*Tabulated data on borings in the vicinity of Jacksonville.*

Map No.	Location T. 15 N., R. 9 W. Section	Part of Section		Company	Farm and Well No.	Elevation Curb	Coal	Top of Miss.	Remarks
1	2	SW	NW	P. C. Irwin et al.....	Conklin No. 1.....	644	.....	334	Gas well
2	2	SW	NW	P. C. Irwin et al.....	Conklin No. 2.....	646	.....	331	Gas well
3	2	SW	NW	P. C. Irwin et al.....	Conklin No. 3.....	646	.....	?	Small gas well
4	2	NW	SW	P. C. Irwin et al.....	A. J. Harris.....	644	.....	?	Dry hole
5	3	NE	NE	P. C. Irwin et al.....	A. J. Harris No. 5.	643	.....	?	Dry hole
6	3	SE	NE	P. C. Irwin et al.....	A. J. Harris No. 1.	644	.....	?	Gas well
7	3	SE	NE	P. C. Irwin et al.....	A. J. Harris No. 2.	644	.....	325?	Gas well
8	3	NE	SE	P. C. Irwin et al.....	A. J. Harris No. 3.	644	.....	333	Gas well
9	3	SE	SW	P. C. Irwin et al.....	A. J. Harris No. 4.	630	.....	340	Gas well
10	3	SW	NW	P. C. Irwin et al.....	L. Trotter No. 2..	636	.....	330	Gas well
11	3	SW	SW	P. C. Irwin et al.....	L. Trotter No. 1..	636	.....	?	Gas well, abandoned
12	4	SE	SW	P. C. Irwin et al.....	Rayburn No. 1....	638	.....	358	Gas, Burlington test
13	5	NE	NE	W. Kennedy.....	D. I. Green No. 1..	637	.....	361	Gas well, abandoned
14	6	NE	SW	W. Kennedy.....	O. Cully No. 1.....	612	.....	?	Dry hole
15	7	SE	SW	..... ?	E. O. Green No. 1.	588	.....	?	
16	8	NW	NW	Timberlake & Higgins.	Cleary No. 2.....	635	427	336	Gas well
17	8	SW	NW	Timberlake & Higgins.	Cleary No. 1.....	634	424	335	Oil well
18	8	NW	NW	Rhodes & Moorehead...	Cleary No. 2.....	586	418	332	Dry hole, Trenton test
19	8	SE	NW	W. Kennedy.....	Cleary No. 1.....	587	.....	?	Gas well, abandoned
20	8	SW	NE	Rhodes & Moorehead...	Mahon No. 1.....	589	432	344	Oil well
21	8	SW	NE	Rhodes & Moorehead...	Mahon No. 2.....	588	431	343	Oil well
22	8	SE	NW	Leeper & Curtis.....	Mahon	587	.....	?	Show oil
23	8	SW	NE	Five Star Petroleum...	Mahon No. 4.....	597	426	350	Show oil
24	8	SW	NE	..... ?	Mahon	589	.....	?	Abandoned
25	8	SE	NW	Timberlake & Higgins.	Mahon No. 7.....	593	434	.....	Oil well
26	8	SW	NE	Timberlake & Higgins.	Mahon No. 8.....	589	426	346	Oil well
27	8	SW	NE	Timberlake & Higgins.	Mahon No. 9.....	595	426	338	Oil well
28	8	NW	SE	Five Star Petroleum...	Coons No. 1.....	613	430	353	Gas well, abandoned
29	8	SE	SW	..... ?	Coons	618	.....	369	Gas, abandoned

TABLE 1.—*Tabulated data on borings in the vicinity of Jacksonville*—Concluded.

Map No.	Location T. 15 N., R. 9 W.			Company	Farm and Well No	Elevation			Remarks
	Section	Part of Section				Curb	Coal	Top of Miss.	
30	8	NW	SE	Benoist Brothers.....	Travis No. 1.....	625	.....	.....	Oil show, abandoned
31	8	NW	SE	(Old well) ?	Travis	619	.....	?	Oil show, abandoned
32	8	NW	SE	Timberlake & Higgins.	Travis No. 10.....	627	421	344	Drilling
33	9	NW	SW	W. Kennedy.....	Masters No. 2.....	633	.....	345	Gas, oil show, aban'd
34	10	SW	NE	P. C. Irwin.....	O'Rear No. 1.....	598	418	313	Gas well
35	15	NW	NW	..... ?	N. O'Rear No. 1...	347	.....	637	Show gas, abandoned
36	16	SE	NE	W. Kennedy.....	I. Tindall No. 2...	634	.....	349	Gas, abandoned
37	16	NE	SE	Leeper & Curtis.....	I. Tindall No. 1...	644	.....	344	Gas, abandoned
38	16	NE	SE	..... ?	I. Tindall.....	644	.....	.....	Gas, abandoned
39	16	SE	NW	W. Kennedy.....	I. Tindall No. 3...	634	.....	349	Gas, abandoned
40	16	SW	NW	W. Kennedy.....	Green	629	.....	?	Gas, abandoned
41	16	NW	NW	W. Kennedy.....	I. Tindall No. 4 ?.	631	.....	?	Gas, abandoned
42	16	NW	SW	W. Kennedy.....	Hemphill	637	358	.....	Gas, abandoned
43	16	NW	NW	W. Kennedy.....	Masters No. 1.....	626	.....	371	Gas, abandoned
44	17	SW	NE	W. Kennedy.....	Travis	629	.....	?	Gas, oil, abandoned
45	17	NW	NW	..... ?	Dunlap	619	.....	?	Show oil, abandoned
46	18	NE	NE	W. Cody et al.....	Conklin No. 2.....	610	.....	?	Show gas, oil, aban'd
47	18	NE	NE	W. Cody et al.....	Conklin No. 1.....	613	.....	361	Show oil, abandoned
48	18	NW	NE	P. C. Irwin et al.....	Conklin No. 4.....	614	.....	?	Show oil, abandoned
49	18	SW	NE	P. C. Irwin et al.....	Conklin No. 5.....	617	.....	357	Dry hole
50	18	SW	NE	P. C. Irwin et al.....	Conklin No. 1.....	617	433	356	Oil well
51	18	SW	NE	P. C. Irwin et al.....	Conklin No. 2.....	610	.....	341	Dry hole
52	18	SW	NE	P. C. Irwin et al.....	Conklin No. 3.....	600	.....	?	Show oil, abandoned
53	18	NE	NW	Frank Byrns et al....	Willerton	599	.....	?	Show oil, abandoned
54	18	SW	NW	Frank Byrns et al....	Willerton	585	.....	?	Oil aban'd, Keokuk test
55	18	SW	NW	Timberlake & Higgins.	Willerton No 1...	582	427	363	Gas well
56	18	NE	SW	P. C. Irwin et al.....	Arnold No. 1.....	594	425	354	Gas abandoned

(Spergen)[4]. There seems to be little doubt that it belongs in the Meramec group and that it is either St. Louis or Salem. The oil-bearing strata vary considerably in lithologic character within relatively short distances. In the two recently drilled wells, Mahon Nos. 8 and 9 (map Nos. 26 and 27), the oil rock is a relatively pure limestone and seems to be entirely lacking in silicious material. On the other hand, the same horizon to the southwest in the Five Star Petroleum Company's Coons No. 1 (map No. 28), to the northwest in the Timberlake and Higgins' Mahon No. 7 (map No. 5), and to the north in the Five Star Petroleum Company's Mahon No. 4 (map No. 23) is represented by a sandy limestone[5]. The same condition was found in a study of the samples from Timberlake and Higgins' Mahon No. 7.

The typical oil-bearing rock from Mahon No. 9 (map No. 27) is a light brown limestone, rather soft, having a finely mottled texture. On examination with the hand lens it is seen to consist of numerous small fragments resembling oolites but more irregular in shape. The interstitial space is partly filled with calcium carbonate, and the remaining open space appears ample to contain oil in commercially extractable quantities.

The impervious rock which confines the oil to certain zones in the Salem limestone appears to be dense non-porous parts of the Salem itself. In Mahon well No. 9 (map No. 27) a bed of sandstone 2 feet thick, containing no gas, oil, or water, lies directly on top of the Salem limestone. A thickness of 18 feet of limestone was drilled through before the first show of oil was encountered. Evidently at least part of this upper 18 feet of the Salem is impervious in this location. The drill cuttings from this "cap rock" are very fine grained in texture and light gray or almost white in color.

As illustrated in the Mahon wells Nos. 8 and 9 (map Nos. 26 and 27), the succession of oil-bearing and barren strata in the Salem varies within comparatively short distances. The porosity of a given bed may vary from place to place, and the oil-bearing zones may to some extent lie across the bedding planes.

Keokuk-Burlington: Gas from a deeper producing horizon was discovered in Timberlake and Higgins' Willerton No. 1 (map No. 55). A small quantity of gas was found in the Salem in this well, and drilling was continued. After passing through 90 feet of Salem limestone and 110 feet of Warsaw formation, chiefly sandy shale, the top of the Keokuk-Burlington was reached at a depth of 421 feet. The 5 3/16-inch casing was set at this depth, and drilling was continued in hard limestone to a depth of 435 feet at which point gas with a pressure of 45 pounds and a slight "rainbow"

[4] Collingwood D. M., Oil and gas development in the vicinity of Jacksonville: Illinois State Geol. Survey Bull. 44B, pp. 12 and 13, 1923.

[5] Idem, pp. 9 to 12 for logs based on sample studies from the two wells of the Five Star Petroleum Company.

of oil were found. Production was estimated at 2,000,000 cubic feet per day.

Figure 2 is designed to show the oil-bearing horizons in relation to the barren strata, and the two logs detailed below example the character of the formations penetrated.

Driller's log from Timberlake and Higgins' well No. 10 (map No. 32) on Travis farm in NW. ¼ SE. ¼ Sec. 8, T. 15 N., R. 9 W.

Elevation—627 Feet

No.		Thickness *Feet*	Depth *Feet*
	Pleistocene system		
1.	Clay, yellow	18	18
2.	Gravel, clay, sand	22	40
	Unconformity		
	Pennsylvanian system		
3.	Shale, blue	24	64
4.	Lime	1	65
5.	Shale	3	68
6.	Gravel and water (coal)	3	71
7.	Slate, dark	9	80
8.	Slate, white	15	95
9.	Lime	1	96
10.	Slate, white	24	120
11.	Shale, gray	54	174
12.	Sandstone	5	179
13.	Shale, dark	23	202
14.	Lime (?)	1	203
15.	Slate, black	3	206
16.	Coal	6	212
17.	Fire clay	12	224
18.	Lime	5	229
19.	Slate, white	16	245
20.	Sand; gas and show of oil	6	251
21.	Sand	6	257
22.	Coal	3	260
23.	Fire clay	6	266
24.	Slate, dark	17	283
	Unconformity		
	Mississippian system		
25.	Lime, white	30	313
26.	Lime; first oil show in limestone	13	326
27.	Lime and green shale	4	330
	Unconformity		
	Mississippian system		
19.	Lime, hard	18	275
20.	Lime, brown; oil show	4	279
21.	Lime, light brown	4	283
22.	Lime, brown	4	289
23.	Lime, white	2	291

Driller's log from Timberlake and Higgins' well No. 9 (map No. 27) on Mahon farm in SW. ¼ NW. ¼ Sec. 8, T. 15 N., R. 9 W.

Elevation—595 Feet

No.		Thickness *Feet*	Depth *Feet*
	Pleistocene system		
1.	Mud, brown	15	15
2.	Hardpan, gravel, water	21	36
3.	Clay, blue; and gravel	29	65
4.	Gravel	12	77
	Unconformity		
	Pennsylvanian system		
5.	Shale	58	135
6.	Lime, dark	9	144
7.	Shale, dark	21	165
8.	Lime	1	166
9.	Shale, black	3	169
10.	Coal	5	174
11.	Lime, gray	7	181
12.	Lime, white	6	187
13.	Shale, gray	41	228
14.	Coal	6	234
15.	Fire clay	4	238
16.	Slate, gray	7	245
17.	Slate, dark	10	255
18.	Sand, hard	2	257

Recent Development

An account of the history of development up to 1922 has already been published[6]. Within the last eight months 13 wells have been drilled in secs. 8 and 18, T. 15 N., R. 9 W. of which 2 are gas producers, 5 oil producers, and 6 dry holes. Among the best of the oil wells are the last two drilled; namely, Timberlake and Higgins' Mahon Nos. 8 and 9 (map Nos. 26 and 27). The character of the oil-bearing rock is such that shooting with nitroglycerin is particularly successful. The showing of oil in Mahon No. 8 before the shot was so small that most operators would not have considered

[6] Collingwood, D. M., Oil and gas development in the vicinity of Jacksonville: Illinois State Geol. Survey Bull. 44B, 1923.

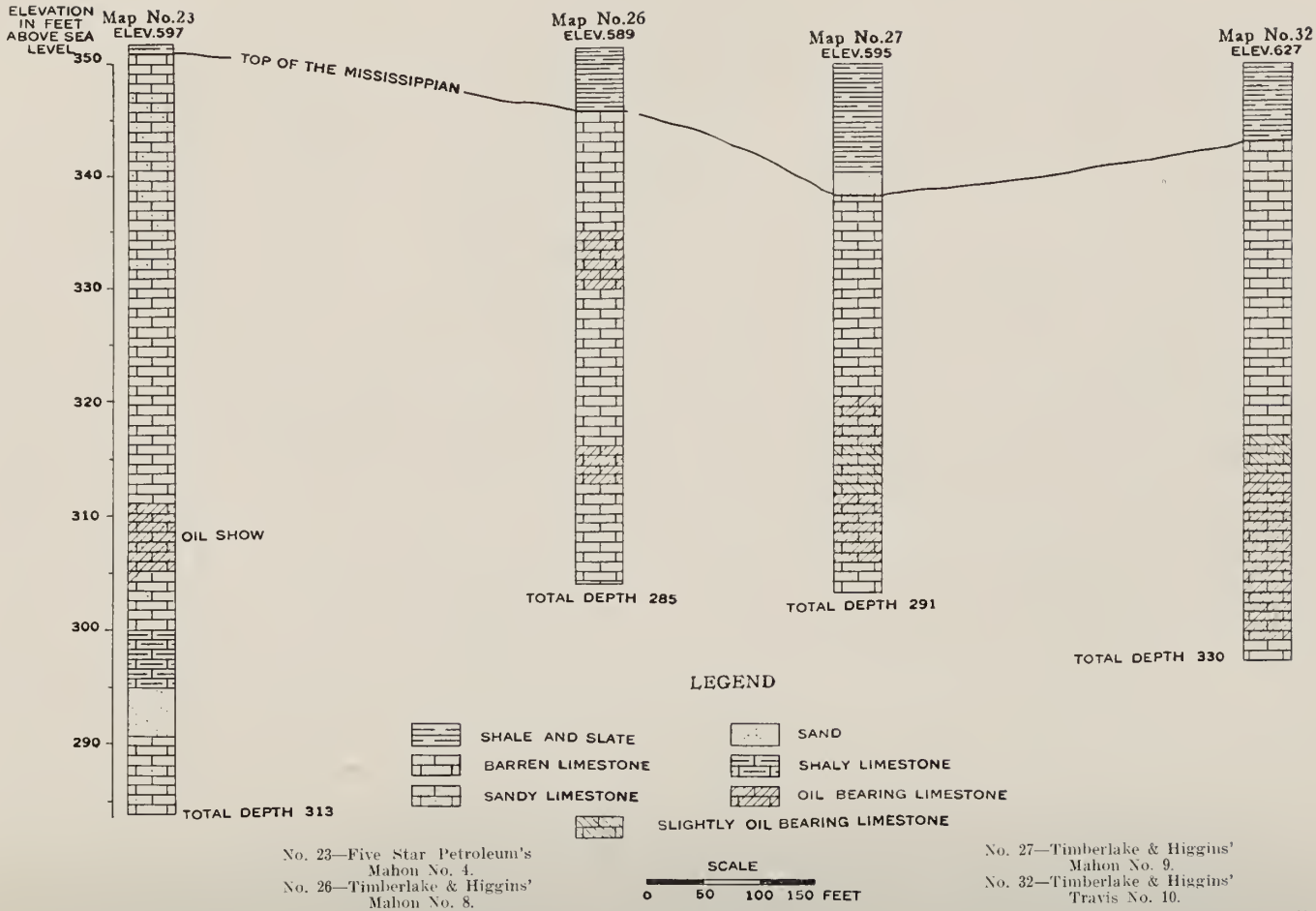

FIG. 2. North-south cross-section through Mahon and Travis farms, sec. 8, T. 15 N., R. 9 W., to show the relation of the oil-bearing horizons to the barren strata.

shooting. However, Mr. Timberlake decided to shoot with 80 quarts of nitroglycerin, and the performance of the well afterwards shows this expenditure to have been justified. Within 3 hours after the shot the oil was standing 75 feet above the bottom. By the time the well was ready to be pumped there was 150 feet of oil in the well. In a 12-hour pumping test it produced 17 barrels of oil of 34° A. P. I. gravity (American Petroleum Institute). Mahon No. 9 had a somewhat better showing of oil before the shot than had No. 8, and it also was shot with 80 quarts. On account of trouble with tubing and valves the well was not pumped continuously for 12 hours, but in a total of 8 hours pumping on two successive days it made 19 barrels of oil.

The most recent well drilled in the area, Timberlake and Higgins' Travis No 10 (map No. 32) was completed on August 17th, total depth 330 feet. It had a show of gas and oil in a Pennsylvanian sand from 245 to 257 feet and a show of oil in the Mississipian from 310 to 328 feet in limestone. At the time of writing it has not yet been shot, but it will probably make a commercial well for the amount of oil showing in the Mississipian is about the same as in Mahon No. 9.

The group of six gas wells on the Harris and Conklin farms in secs. 2 and 3, T. 15 N. R. 9 W. were drilled by P. C. Irwin and his associates in 1923. The best well, Harris No. 3 (map No. 3) gauged 9.3 million cubic feet per 24 hours. All the rest except Conklin No. 3 which was considerably lighter gauged in the neighborhood of 2,000,000 cubic feet. The owners of these wells have recently completed the construction of five miles of 6-inch and four miles of 8-inch pipe line to the city of Jacksonville. About August 1st natural gas was turned on in Jacksonville and is being used mixed with artificial gas to the extent of a quarter of a million cubic feet per day. At present only two wells are being used; namely, Conklin Nos. 1 and 2 (map Nos. 1 and 2). The pressure in the main is 55 pounds, and this is reduced to seven pounds at the city limits.

Recommendations

It seems probable that oil production will be found to extend some distance south, southeast, and east of the present productive area on the Mahon lease. It will probably be found most advantageous to "feel out" this acreage by moving outwards, one location at a time, in these directions.

The occurence of gas at a number of localities in the surrounding region and the association of oil with gas in secs. 8 and 18, T. 15 N., R. 9 W. suggest the possibility of the occurrence of oil in commercial quantities in the

same geologic horizon in other localities than those in which it is already known. At present the lack of adequate knowledge of structural conditions prevents the making of any very specific recommendations as to territory worthy of wildcat testing. Much of this lack of geological data must be attributed to the fact that only meager records were kept of the great majority of the earlier wells drilled. Those who have been operating more recently in the region are to be congratulated on the way in which they have cooperated in the geological study of the area by keeping detailed logs and samples of cuttings. These data will be an invaluable aid in future development in the area.

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